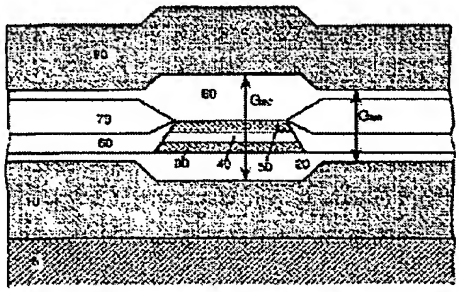
MAGNETO-RESISTANCE EFFECT TYPE REPRODUCING HEAD AND MAGNETIC RECORDING AND REPRODUCING DEVICE

Publication number: JP11025431
Publication date: 1999-01-29
Inventor: ISHIKAWA CHIAKI; TOTSUKA KO; SUZUKI YOSHIO
Applicant: HITACHI LTD
Classification:
- international: *G11B5/39;* G11B5/39; (IPC1-7): G11B5/39
- European:
Application number: JP19970182103 19970708
Priority number(s): JP19970182103 19970708

Report a data error here

Abstract of **JP11025431**

PROBLEM TO BE SOLVED: To reduce a blot on reproducing sensitivity in weakening a magnetic field from a medium to be worked upon both sides of magnetism sensitive parts by making a space of a magnetic shield film between positions of electrode parts provided on both end parts of a magneto-resistance effect film in the longitudinal direction narrower than or the same as a space of a magnetic shield film between the magnetism sensitive parts. SOLUTION: The lower shield film 10 is formed on a substrate 5 and laminated with an organic resist film, and is then patterned with a prescribed shape in an area equivalent to a track width and is laminated with a lower magnetic gap forming insulation film 20, a soft magnetic film 30, a nonmagnetic electroconductive film 40 and a magneto-resistance effect film 50. Subsequently, after laminating an organic resist film, patterning it into a desired shape is performed. Then, a permanent magnet film 60 is laminated and processed to be a desired shape, and is then Nb/Au/Nb are laminated and processed to make an electrode 70. Subsequently, after laminating an upper magnetic gap forming insulation film 80, the insulation film 80 in its area equivalent to the track width is removed to form a prescribed step. In this MR head, the space of the magnetic shield film between the electrode part positions is narrower than that between the magnetism sensitive part positions by 0.1 &mu m.



(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平11－25431

(43)公開日　平成11年(1999)１月29日

(51)Int.Cl.[6]	識別記号	ＦＩ
Ｇ１１Ｂ　5/39		Ｃ１１Ｂ　5/39

審査請求　未請求　請求項の数７　ＯＬ　（全　６　頁）

(21)出願番号　特願平9－182103

(22)出願日　平成９年(1997)７月８日

(71)出願人　000005108
株式会社日立製作所
東京都千代田区神田駿河台四丁目６番地

(72)発明者　石川　千明
東京都国分寺市東恋ケ窪一丁目280番地
株式会社日立製作所中央研究所内

(72)発明者　戸塚　秀
東京都国分寺市東恋ケ窪一丁目280番地
株式会社日立製作所中央研究所内

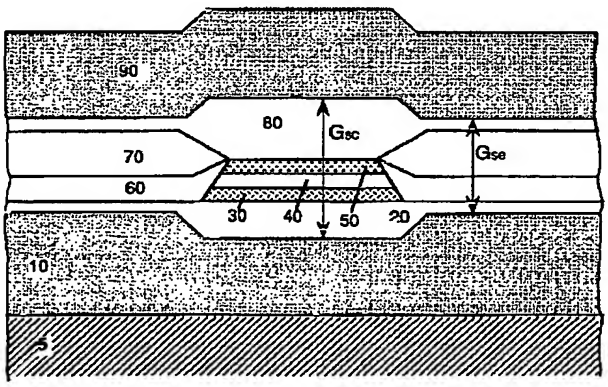
(72)発明者　鈴木　良夫
東京都国分寺市東恋ケ窪一丁目280番地
株式会社日立製作所中央研究所内

(74)代理人　弁理士　小川　勝男

(54)【発明の名称】　磁気抵抗効果型再生ヘッドならびに磁気記録再生装置

(57)【要約】
【課題】クロストーク量が小さく、しかも、安定に動作する磁気抵抗効果型再生ヘッドを提供する。
【解決手段】電極部位置における磁気シールド膜の間隔を、感磁部位置における磁気シールド膜の間隔と同じかもしくは狭くする。

図１



【特許請求の範囲】
【請求項１】磁気抵抗効果膜と、前記磁気抵抗効果膜に電流を流すための一対の電極と、前記磁気抵抗効果膜に横バイアス磁界を印加するための手段と、前記磁気抵抗効果膜に縦バイアス磁界を印加するための手段とを含む磁気抵抗効果素子が、積層方向に離間して設けられた一対の磁気シールド膜の間に配置されている磁気抵抗効果型ヘッドにおいて、前記電極部位置における磁気シールド膜の間隔が、感磁部位置における磁気シールド膜の間隔より狭い、もしくは同じであることを特徴とする磁気抵抗効果型再生ヘッド。
【請求項２】少なくとも２層の磁性層及びそれらを分離する非磁性層からなる磁気抵抗効果膜および上記磁気抵抗効果膜に電流を供給する一対の電極を有し、上記２つの磁性層の磁化の向きの差によって抵抗変化を得る磁気抵抗効果素子が、積層方向に離間して設けられた一対の磁気シールド膜の間に配置されている磁気抵抗効果型ヘッドにおいて、前記電極部位置における磁気シールド膜の間隔が、感磁部位置における磁気シールド膜の間隔より狭い、もしくは同じであることを特徴とする磁気抵抗効果型再生ヘッド。
【請求項３】上記電極部位置における磁気シールド膜の間隔Gseと感磁部位置における磁気シールド膜の間隔Gscの比Gse／Gscが、０．６ から１であることを特徴とする請求項１又は２の磁気抵抗効果型再生ヘッド。
【請求項４】基板上に積層して設けられた横バイアス磁界印加用の軟磁性膜，非磁性導電膜及び磁気抵抗効果膜、前記磁気抵抗効果膜の長手方向両端部に設けられた縦バイアス磁界印加用の一対の永久磁石膜、並びに前記一対の永久磁石膜上に設けられた一対の電極とを備えることを特徴とする請求項１の磁気抵抗効果型再生ヘッド。
【請求項５】少なくとも２層の磁性層及びそれらを分離する非磁性層からなる磁気抵抗効果膜のうち少なくとも１層に接して反強磁性膜を設け、この反強磁性膜との磁気的な交換結合によって、上記磁性層の磁化に一方向異方性が印加されており、さらに、前記磁気抵抗効果膜の長手方向両端部に縦バイアス磁界印加用の一対の永久磁石膜を備えることを特徴とする請求項２の磁気抵抗効果型再生ヘッド。
【請求項６】一対の磁極、該一対の磁極を磁気的に結合する磁気回路手段および前記磁気回路に鎖交するコイルを含む磁気記録用誘導型薄膜ヘッドと、前記請求項１～５のいずれか一項に記載の磁気抵抗効果型再生ヘッドとを備えることを特徴とする記録再生分離型磁気ヘッド。
【請求項７】磁気記録媒体と、請求項１～６のいずれか一項に記載のヘッドと前記磁気記録媒体と前記ヘッドとを相対的に駆動する駆動手段と、前記ヘッドに接続された記録再生信号処理計とを含むことを特徴とする磁気記録再生装置。

【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、磁気記録媒体から情報信号を読み取るための再生ヘッドに係り、特に改良された磁気抵抗効果型再生ヘッドならびにそれを用いた磁気記録再生装置に関するものである。
【０００２】
【従来の技術】磁気記録の高密度化に伴い、再生用磁気ヘッドに高い感度が求められている。高感度の再生磁気ヘッドとして、磁気抵抗効果型ヘッド（ＭＲヘッド）と呼ばれるものが知られている。磁気抵抗効果型ヘッドは、記録媒体からの磁界を、素子の抵抗変化として検出する。従来の一般的な磁気抵抗効果型ヘッドは、抵抗が磁化と電流方向との間の角度θの関数として$\cos 2\theta$ に比例して変化する成分を持つという、異方性磁気抵抗効果（ＡＭＲ）に基づいて動作する。
【０００３】一方、異方性磁気抵抗効果とは別の原理で動作する磁気抵抗効果型ヘッドとして、フィジカル　レビュー(Physical Review)Ｂ，第４３巻，１２９７～１３００頁「軟磁性多層膜における巨大磁気抵抗効果」に記載のように２層の磁性層を非磁性層で分離し、一方の磁性層に反強磁性層からの交換バイアス磁界を印加する構造のヘッドが知られている。このような多層膜においては、抵抗Ｒは、２層の磁性層の磁化の間の角θに関数として、$\cos\theta$ に比例して変化する成分を有することが、上記論文に示されており、このような効果を、巨大磁気抵抗効果(GMR)と呼んでいる。このような、多層膜の巨大磁気抵抗効果を利用した磁気抵抗効果型ヘッドは、異方性磁気抵抗効果を利用したヘッドと比べて、大きい磁気抵抗変化量ΔＲを示すことが知られている。
【０００４】一般に、ＡＭＲヘッドおよびＧＭＲヘッドでは、高透磁率の軟磁性材料からなるシールド膜を、媒体走行方向に対して、磁気抵抗効果膜の前後に配置した構造をとる。これは、磁気抵抗効果膜に流入する信号磁界を、磁気抵抗効果膜の端部にまで効率よく導き、磁気抵抗効果膜を均一に磁化させるためである。また同時に、隣接するビットからの漏れ磁界を遮断する。このような構造は線記録密度を高めて、再生出力を高める方法として有効であることが知られている。
【０００５】図７に従来のＭＲヘッドの断面を示す。従来のＭＲヘッドでは、基板５上に均一な膜厚を有する磁気シールド層１０および磁気ギャップ層２０を形成し、その上にパターニングされた磁気抵抗効果膜（３０，４０，５０）と、その両端部に、磁気抵抗効果膜よりも膜厚が大きい電極膜７０および永久磁石６０が配置される。さらに、その上に、均一な膜厚の磁気ギャップ層８０を介して磁気シールド膜９０を形成するため、電極部位置における磁気シールド膜の間隔Gseは、磁気抵抗効果膜（感磁部）位置における磁気シールド膜の間隔Gscより広い構造になっている。

【０００６】
【発明が解決しようとする課題】この従来技術においては、トラック幅方向の感度分布の裾が長いため、高いトラック密度での再生において、隣接トラックからのクロストークが大きいという問題があった。また、記録ヘッドからの強い磁界がＭＲヘッドに印加された場合、磁気抵抗効果膜の長手方向両端部に設けられた縦バイアス磁界印加用の永久磁石膜の磁化状態が変化して、ＭＲヘッドの出力が不安定になるという問題があった。
【０００７】本発明は安定に動作し、しかも、高トラック密度に適したＭＲヘッドを提供することを目的とするものである。
【０００８】
【課題を解決するための手段】上記目的は、磁気抵抗効果膜の長手方向両端部に設けられた電極部位置における磁気シールド膜の間隔を、感磁部位置における磁気シールド膜の間隔より狭くするか、もしくは同じとすることにより達成される。
【０００９】ここで、上記電極部位置における磁気シールド膜の間隔Gseと感磁部位置における磁気シールド膜の間隔Gscの比Gse／Gscが、０．６ から１であることが好ましい。
【００１０】また、本発明の磁気抵抗効果型再生ヘッドは、磁気記録用誘導型薄膜ヘッドと組み合わせて、記録再生分離型磁気ヘッドを構成することができる。
【００１１】磁気シールド空隙内部に流入する記録媒体からの磁界や記録ヘッドからの磁界は、磁気シールド膜の間隔が狭いほど、その強度が弱まる。上述のように、電極部位置における磁気シールド膜の間隔を、従来より狭くすると、感磁部の両側にかかる媒体からの磁界が弱まるため、再生感度のにじみを低減でき、隣接トラックからのクロストークを低減できる。
【００１２】さらに、感磁部の長手方向両端部に設けられた永久磁石膜に印加される磁界も減少するため、媒体および記録ヘッドからの磁界による永久磁石膜の磁化状態の変化が低減でき、ＭＲヘッドの出力安定性を向上することができる。
【００１３】
【発明の実施の形態】以下、本発明の実施例について詳細に説明する。
【００１４】（実施例１）本発明による代表的な磁気抵抗効果型ヘッドの断面図を図１に示す。基板５上に、厚さ２μｍの下部シールド膜（ＮｉＦｅ膜）１０を形成し、有機レジスト膜を積層した後、ほぼトラック幅に相当する領域で、約６５ｎｍの段差がつくようにパターニングを行った。次に、磁気ギャップ形成用絶縁膜（Ａｌ２Ｏ３膜）２０を形成して、トラック幅に相当する領域における厚さが８５ｎｍ、それ以外の領域における厚さが２０ｎｍとなるように加工した。さらに、厚さ２０ｎｍの軟磁性膜（ＮｉＦｅＮｂ膜）３０，厚さ１０ｎｍの非磁性導電膜（Ｔａ膜）４０，厚さ２０ｎｍの磁気抵抗効果膜（ＮｉＦｅ膜）５０を積層した。
【００１５】次に、有機レジスト膜を積層した後、所望の形状にパターニングを行った。さらに、厚さ３０ｎｍの永久磁石膜（ＣｏＣｒＰｔ膜）６０を積層し、所望の形状に加工した後、Ｎｂ／Ａｕ／Ｎｂを積層，加工し電極７０とした。さらに、厚さ１１５ｎｍの磁気ギャップ形成用絶縁膜（Ａｌ２Ｏ３膜）８０を積層したのち、トラック幅に相当する領域で約３５ｎｍの段差がつくように、トラック幅の両側部分に相当する絶縁膜８０を除去した。さらにその上に厚さ２μｍの上部シールド膜（ＮｉＦｅ膜）９０を積層し所望の形状に加工して磁気ヘッドとした。
【００１６】本実施例におけるＭＲヘッドは、電極部位置における磁気シールド膜の間隔Gseが、感磁部位置における磁気シールド膜の間隔Gscより０．１μｍ 狭く、Gse／Gscが、０．６の構造である。
【００１７】図２は本実施例のヘッド（ａ）と、電極部位置における磁気シールド膜の間隔が感磁部位置における磁気シールド膜の間隔より８０ｎｍ広い従来ヘッド（ｂ）の、トラック幅方向の感度分布を示したものである。ヘッドのトラック幅より狭い領域に記録した媒体を、トラック幅方向に移動しながら再生出力を測定した。図からわかるように本発明のヘッド（ａ）は、従来ヘッド（ｂ）に比べて、感度分布における裾のひろがりを低減することができた。実際、ヘッドが隣の媒体の端部と０．３μｍ 重なったオフトラック時に再生を行った結果、ヘッド（ａ）のクロストーク量は（ｂ）より約８ｄＢ減少した。
【００１８】電極部位置における磁気シールド膜の間隔Gseと、感磁部位置における磁気シールド膜の間隔Gscの比、Gse／Gscが異なるＭＲヘッドをいくつか作製し、それぞれのクロストーク量を上記条件で測定した結果を図３に示す。Gse／Gscが小さいほどクロストーク量は減少し、Gse／Gscが１～０．６ のとき、従来ヘッド（Gse／Gsc＝１．３）に比べて、クロストーク量が６．５～８ｄＢ減少した。本実施例では、絶縁膜の薄膜化の限界から、Gse／Gscを０．６ 以下とすることは困難であった。
【００１９】さらに、本実施例のヘッドでは、記録ヘッドからの磁界がＭＲヘッドに印加された後も再生出力が低下することなく、従来ヘッドより、出力が安定に動作することが確認できた。
【００２０】（実施例２）図４に、本発明による別の実施例として、巨大磁気抵抗効果型ヘッドに適用した磁気ヘッドの断面図を示す。このヘッドの作製に当たっては、基板５上に、下部シールド膜（ＮｉＦｅ膜）１０，磁気ギャップ形成用絶縁膜（Ａｌ２Ｏ３膜）２０を実施例１と同様に形成し、巨大磁気抵抗効果膜１００として、ＮｉＦｅ／Ｃｏ，Ｃｕ，ＣｏＦｅ，ＦｅＭｎを順次積層し

たものを用いた。次に、有機レジスト膜を積層した後、所望の形状にパターニングを行い、さらに、永久磁石膜（ＣｏＣｒＰｔ膜）６０を積層して、所望の形状に加工した後、Ｎｂ／Ａｕ／　Ｎｂを積層、加工し電極７０とした。また、磁気ギャップ形成用絶縁膜（ＡｌＯ膜）８０は、実施例１と同様の段差がつくように形成した。さらにその上に厚さ２μｍの上部シールド膜（ＮｉＦｅ膜）９０を積層し所望の形状に加工して磁気ヘッドとした。

【００２１】本実施例におけるＧＭＲヘッドにおいても、電極部位置における磁気シールド膜の間隔Gseが、感磁部位置における磁気シールド膜の間隔Gscより狭く、Gse／Gscは０.６である。

【００２２】本発明によるＧＭＲヘッドは、Gse／Gscが１.３ の従来のＧＭＲヘッドに比べて、トラック幅方向の感度分布における裾ひろがりが少なく、実施例１で示した測定によるクロストーク量は約１.０ｄＢ減少した。

【００２３】さらに、本発明のＧＭＲヘッドに記録ヘッドからの磁界がＭＲヘッドに印加された後も、再生出力が低下することなく、従来ヘッドより、出力が安定に動作することが確認できた。

【００２４】（実施例３）本発明の磁気抵抗効果素子を再生用ヘッドに用い、従来公知の誘導型薄膜ヘッドを記録用ヘッドとして用いる記録再生分離型磁気ヘッドを作製した。図５に、本実施例による記録再生分離型ヘッドの一部分を切断した斜視図を示す。ＡｌＯ・ＴｉＣを主成分とする焼結体をスライダ用の基板５とした。前記実施例１に示した方法により段差を設けた下部シールド膜１０および、磁気ギャップ形成用絶縁膜（ＡｌＯ膜）を作製した。その上に、軟磁性膜（ＮｉＦｅＮｂ膜）３０，非磁性導電膜（Ｔａ膜）４０，磁気抵抗効果膜（ＮｉＦｅ膜）５０，有機レジスト膜を積層した後、所望の形状にパターニングを行った。さらに、永久磁石膜（ＣｏＣｒＰｔ膜）を積層し所望の形状に加工した後、Ｎｂ／Ａｕ／Ｎｂ７０を積層，加工して電極とした。さらにその上に、前記実施例１と同様の段差を設けた磁気ギャップ形成膜（ＡｌＯ膜），磁気シールド膜（ＮｉＦｅ膜）９０を形成した。以上の部分が再生ヘッドとして働く。

【００２５】次に、磁気記録用ヘッドとして、厚さ３μｍのＡｌＯからなる絶縁膜を形成した後、下部磁極１１０，上部磁極１２０およびコイル１３０からなる誘導型薄膜ヘッドを形成した。下部磁極１１０，上部磁極１２０には、スパッタリング法で形成した膜厚３.０μｍ のＮｉ－２０ａｔ％Ｆｅ合金を用いた。下部磁極１１０および上部磁極１２０の間のギャップには、スパッタリング法で形成した膜厚０.２μｍのＡｌＯを用いた。コイル１３０には、膜厚３.０μｍのＣｕを使用した。下部磁極１１０と上部磁極１２０は磁気的に結合して磁気回路を構成し、コイル１３０はその磁気回路に鎖交している。

【００２６】本発明による記録再生分離型磁気ヘッドも従来のヘッドに比べて、トラック幅方向の感度分布における裾ひろがりが少なく、実施例１で示した測定によるクロストーク量は約８ｄＢ減少した。

【００２７】（実施例４）前記実施例３で述べた本発明による磁気ヘッドを用い、磁気ディスク装置を作製した。図６に磁気ディスク装置の構造の概略を示す。

【００２８】磁気記録媒体１４０には、残留磁束密度０.７５Ｔ のＣｏ－Ｎｉ－Ｐｔ－Ｔａ系合金からなる材料を用いた。磁気記録媒体１４０は駆動部１５０によって回転駆動される。磁気ヘッド１６０の記録ヘッドのトラック幅は２μｍ、再生ヘッドのトラック幅は１.５μｍ とした。磁気ヘッド１６０は、駆動部１７０によって回転駆動されて磁気記録媒体１４０上のトラックを選択できる。磁気ヘッド160による記録再生信号は記録再生信号処理系１８０で処理される。

【００２９】磁気ヘッド１６０に用いた磁気抵抗効果ヘッドは、従来の構造の磁気抵抗効果ヘッドより、隣接トラックからのクロストークが小さく、出力も安定なため、さらにトラック幅が狭く、記録密度の高い磁気ディスク装置を作製することもできる。

【００３０】

【発明の効果】本発明によると、磁気抵抗効果型再生ヘッドにおける感磁部のトラック幅両端部に印加される磁界が減少するため、トラック幅方向の再生感度のにじみを低減でき、隣接トラックからのクロストークを低減できる。さらに、安定な再生出力を有する磁気抵抗効果型再生ヘッドを得ることができる。

【図面の簡単な説明】

【図１】本発明による磁気抵抗効果型ヘッドの断面図。

【図２】本発明によるヘッドと従来ヘッドにおけるトラック幅方向の感度分布を示す図。

【図３】電極部位置におけるシールド間隔Gseと感磁部位置におけるシールド間隔Gscの比Gse／Gscと、クロストラック量の関係を示す図。

【図４】本発明による巨大磁気抵抗効果型ヘッドの断面図。

【図５】本発明の磁気抵抗効型ヘッドを用いた記録再生分離型磁気ヘッドの構造を示す斜視図。

【図６】本発明による記録再生装置の概略。

【図７】従来の磁気抵抗効果型ヘッドの断面図。

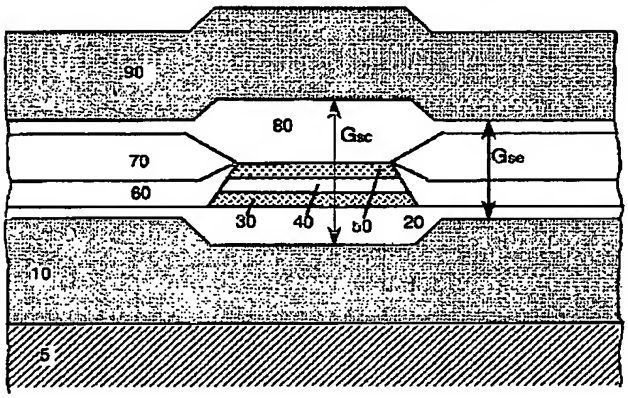
【符号の説明】

５…基板、１０…下部シールド膜、２０…下部磁気ギャップ形成用絶縁膜、３０…軟磁性膜、４０…非磁性導電膜、５０…磁気抵抗効果膜、６０…永久磁石膜、７０…電極、８０…上部磁気ギャップ形成用絶縁膜、９０…上部シールド膜、１００…巨大磁気抵抗効果膜、１１０…記録ヘッド用下部磁極、１２０…記録ヘッド用上部磁

極、１３０…コイル、１４０…磁気記録媒体、１５０…磁気記録媒体駆動部、１６０…磁気ヘッド、１７０…磁気ヘッド駆動部、１８０…記録再生信号処理系。

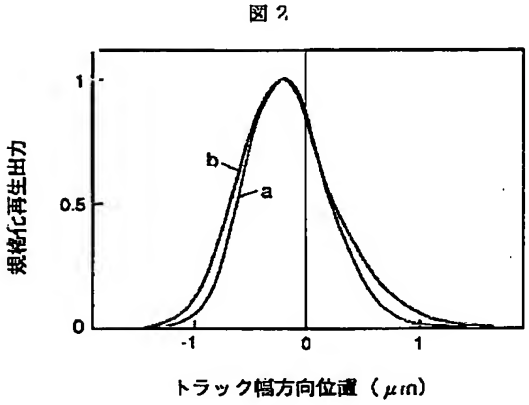
【図１】

図１



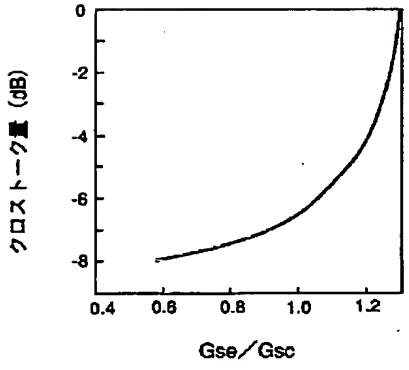
【図２】

図２



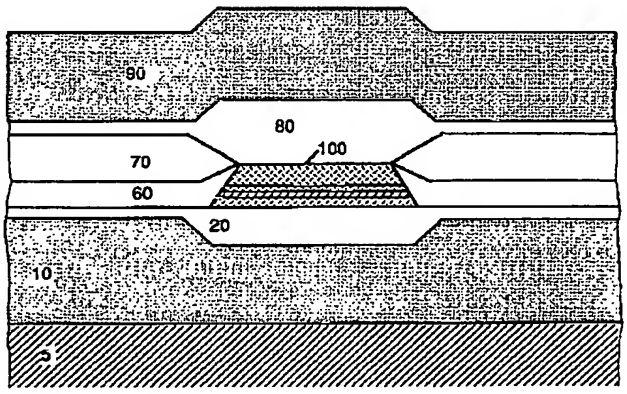
【図３】

図３



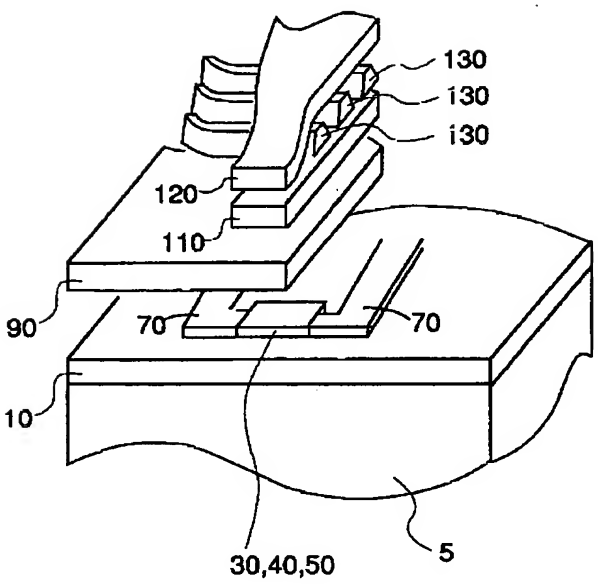
【図４】

図４



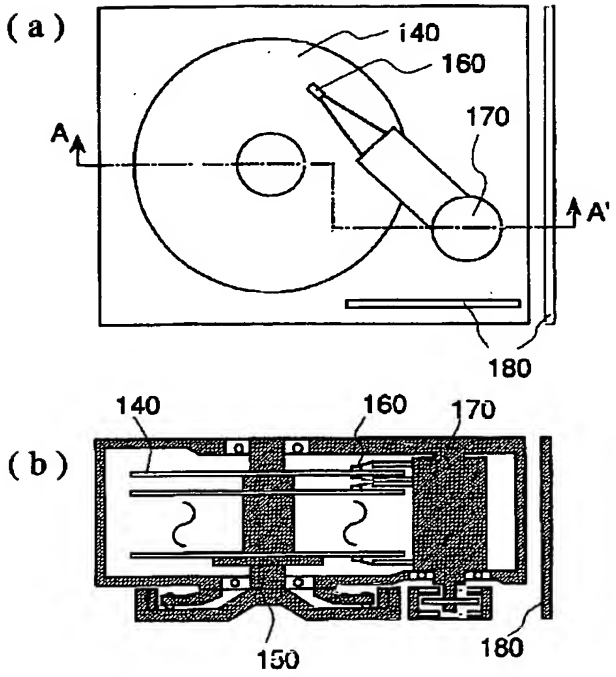
【図５】

図５



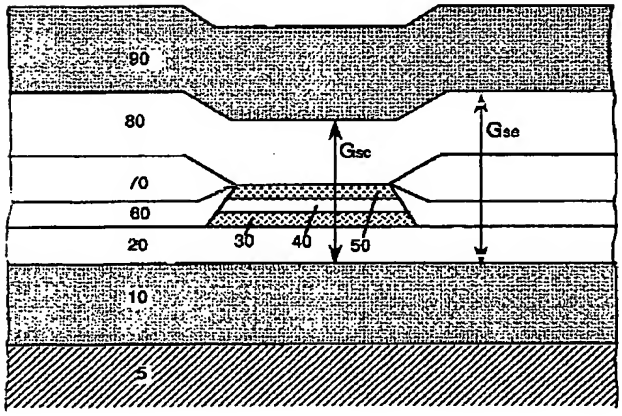
【図６】

図６



【図７】

図７



* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]In a magneto resistance effect type head arranged between magnetic shielding films of a couple characterized by comprising the following in which a magneto resistance effect element was estranged and provided in a laminating direction, A magneto resistance effect type reproduction head which an interval of a magnetic shielding film in said polar-zone position is narrower than an interval of a magnetic shielding film in a magnetic force sensor position, or is characterized by the same thing.
A magneto resistance effect film.
An electrode of a couple for sending current through said magneto resistance effect film.
A means for impressing a transverse bias magnetic field to said magneto resistance effect film.
A means for impressing a longitudinal bias magnetic field to said magneto resistance effect film.

[Claim 2]It has an electrode of a couple which supplies current to a magneto resistance effect film which consists of a non-magnetic layer which separates a two-layer magnetic layer and them at least, and the above-mentioned magneto resistance effect film, In a magneto resistance effect type head arranged between magnetic shielding films of a couple by which a magneto resistance effect element which obtains a resistance change was estranged and provided in a laminating direction according to a difference of direction of magnetization of the two above-mentioned magnetic layers, A magneto resistance effect type reproduction head which an interval of a magnetic shielding film in said polar-zone position is narrower than an interval of a magnetic shielding film in a magnetic force sensor position, or is characterized by the same thing.
[Claim 3]a ratio of the interval Gse of a magnetic shielding film in the above-mentioned polar-zone position to the interval Gsc of a magnetic shielding film in a magnetic force sensor

position -- claim 1, wherein Gse/Gsc is 0.6 to 1, or a magneto resistance effect type reproduction head of 2.

[Claim 4]A soft magnetism film, a nonmagnetic conducting film, and a magneto resistance effect film for transverse bias magnetic field impression provided by laminating on a substrate, A magneto resistance effect type reproduction head of claim 1 provided with an electrode of a couple provided on a permanent magnet film of a couple for longitudinal bias magnetic field impression provided in longitudinal direction both ends of said magneto resistance effect film, and a permanent magnet film of said couple.

[Claim 5]In contact with at least one layer in a magneto resistance effect film which consists of a non-magnetic layer which separates a two-layer magnetic layer and them at least, provide an antiferromagnetism film, and by magnetic switched connection with this antiferromagnetism film. A magneto resistance effect type reproduction head of claim 2 which one-way anisotropy is impressed to magnetization of the above-mentioned magnetic layer, and is further characterized by equipping longitudinal direction both ends of said magneto resistance effect film with a permanent magnet film of a couple for longitudinal bias magnetic field impression.

[Claim 6]A record reproduction discrete type magnetic head comprising:

An induction type thin film head for magnetic recording containing a coil which interlinks a magnetic pole of a couple, and a magnetic pole of this couple to a magnetic-circuit means to join together magnetically, and said magnetic circuit.

Said magneto resistance effect type reproduction head according to any one of claims 1 to 5.

[Claim 7]A magnetic recorder and reproducing device comprising:

A magnetic recording medium.

A driving means which drives relatively a head according to any one of claims 1 to 6, said magnetic recording medium, and said head.

A record reproduction signal-processing meter connected to said head.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the magnetic recorder and reproducing device using the magneto resistance effect type reproduction head and it which started the playback head for reading an information signal in a magnetic recording medium, especially were improved.
[0002]
[Description of the Prior Art]The magnetic head for reproduction is asked for high sensitivity in connection with the densification of magnetic recording. As reproducing magnetic heads of high sensitivity, what is called a magneto resistance effect type head (MR head) is known. A magneto resistance effect type head detects the magnetic field from a recording medium as a resistance change of an element. Resistance of the conventional general magneto resistance effect type head is cos2theta as a function of the angle theta between magnetization and a current direction. It operates based on an anisotropic magneto resistance effect [say / having an ingredient which changes proportionally] (AMR).
[0003]As a magneto resistance effect type head which operates by a principle different from an anisotropic magneto resistance effect on the other hand, Physical A two-layer magnetic layer is divided into the review (Physical Review) B, the 43rd volume, and 1297-1300 pages "giant magneto-resistance in a soft magnetism multilayer film" by a non-magnetic layer like a statement, The head of the structure of impressing the exchange bias magnetic field from an antiferromagnetism layer to one magnetic layer is known. In such a multilayer film, the resistance R is costheta as a function to the angle theta between magnetization of a two-layer magnetic layer. Having an ingredient which changes proportionally is shown in the above-mentioned paper, and it is calling such an effect giant magneto-resistance (GMR). It is known that the magneto resistance effect type head using such giant magneto-resistance of the

multilayer film shows large amount of magnetoresistance changes deltaR compared with the head using an anisotropic magneto resistance effect.

[0004]Generally, in the AMR head and a GMR head, the structure which has arranged the shield film which consists of soft magnetic materials of high magnetic permeability before and after a magneto resistance effect film to a medium traveling direction is taken. This is for leading efficiently the signal magnetic field which flows into a magneto resistance effect film even to the end of a magneto resistance effect film, and making a magneto resistance effect film magnetize uniformly. The leak magnetic field from the adjoining bit is intercepted simultaneously. It is known that it is effective as a method of such a structure raising linear recording density and heightening a reproducing output.

[0005]The section of the conventional MR head is shown in drawing 7. The magneto resistance effect film (30, 40, 50) which formed the magnetic shielding layer 10 and the magnetic gap layer 20 which have uniform thickness on the substrate 5 in the conventional MR head, and was patterned on it, To the both ends, the electrode layer 70 and the permanent magnet 60 with larger thickness than a magneto resistance effect film are arranged. In order to form the magnetic shielding film 90 via the magnetic gap layer 80 of uniform thickness on it, the interval Gse of the magnetic shielding film in a polar-zone position has a structure larger than the interval Gsc of the magnetic shielding film in a magneto resistance effect film (magnetic force sensor) position.

[0006]

[Problem(s) to be Solved by the Invention]In this conventional technology, since the skirt of the sensitivity distribution of a track width direction was long, in reproduction with high track density, there was a problem that the cross talk from an adjacent track was large. When the strong magnetic field from a recording head was impressed to an MR head, the magnetized state of the permanent magnet film for longitudinal bias magnetic field impression provided in the longitudinal direction both ends of the magneto resistance effect film changed, and there was a problem that the output of an MR head became unstable.

[0007]This invention operates stably and an object of this invention is to provide an MR head suitable for high track density moreover.

[0008]

[Means for Solving the Problem]The above-mentioned purpose is attained by making narrower than an interval of a magnetic shielding film in a magnetic force sensor position an interval of a magnetic shielding film in a polar-zone position provided in longitudinal direction both ends of a magneto resistance effect film, or supposing that it is the same.

[0009]a ratio of the interval Gse of a magnetic shielding film [in / here / the above-mentioned polar-zone position] to the interval Gsc of a magnetic shielding film in a magnetic force sensor position -- it is preferred that Gse/Gsc is 0.6 to 1.

[0010]The magneto resistance effect type reproduction head of this invention can constitute a record reproduction discrete type magnetic head combining an induction type thin film head for magnetic recording.

[0011]As for a magnetic field from a recording medium and a magnetic field from a recording head which flow into an inside of a magnetic-shielding opening, the intensity becomes weaker, so that an interval of a magnetic shielding film is narrow. As mentioned above, since a magnetic field from a medium concerning both sides of a magnetic force sensor will become weaker if an interval of a magnetic shielding film in a polar-zone position is made narrower than before, a blot of reproduction sensitivity can be reduced and a cross talk from an adjacent track can be reduced.

[0012]Since a magnetic field impressed to a permanent magnet film provided in longitudinal direction both ends of a magnetic force sensor also decreases, change of a magnetized state of a permanent magnet film by medium and a magnetic field from a recording head can be reduced, and the output stability of an MR head can be improved.

[0013]

[Embodiment of the Invention]Hereafter, the example of this invention is described in detail.

[0014](Example 1) The sectional view of the typical magneto resistance effect type head by this invention is shown in drawing 1. After forming the 2-micrometer-thick lower part shield film (NiFe film) 10 on the substrate 5 and laminating an organic resist film, it patterned in the field which is mostly equivalent to the width of recording track so that the level difference of about 65 nm might stick. Next, the insulator layer 20 for magnetic gap formation (AlO film) was formed, and it was processed so that thickness [in / in the thickness in the field equivalent to the width of recording track / 85 nm and the other field] might be set to 20 nm. The 20-nm-thick soft magnetism film (NiFeNb film) 30, the 10-nm-thick nonmagnetic conducting film (Ta film) 40, and the 20-nm-thick magneto resistance effect film (NiFe film) 50 were laminated.

[0015]Next, after laminating an organic resist film, it patterned after desired shape. After laminating the 30-nm-thick permanent magnet film (CoCrPt film) 60 and processing desired shape, Nb/Au/Nb was laminated and processed and it was considered as the electrode 70. After laminating the 115-nm-thick insulator layer 80 for magnetic gap formation (AlO film), the insulator layer 80 equivalent to the both-sides portion of the width of recording track was removed so that the level difference of about 35 nm might stick in the field equivalent to the width of recording track. Furthermore, the 2-micrometer-thick upper shielding film (NiFe film) 90 was laminated on it, desired shape was processed, and it was considered as the magnetic head.

[0016]The interval [of the MR head in this example] Gse of the magnetic shielding film in a polar-zone position is 0.1 micrometer from the interval Gsc of the magnetic shielding film in a magnetic force sensor position. It is narrow and Gse/Gsc is the structure of 0.6.

[0017]Drawing 2 shows the sensitivity distribution of a track width direction of a head (b) conventionally the head (a) of this example and the interval of the magnetic shielding film in a polar-zone position are conventionally larger than the interval of the magnetic shielding film in a magnetic force sensor position 80 nm. The reproducing output was measured moving the medium recorded on the field narrower than the width of recording track of a head to a track width direction. As shown in a figure, the head (a) of this invention was able to reduce a spread of the skirt in sensitivity distribution compared with the head (b) conventionally. Heads are actually an end of the next medium, and 0.3 micrometer. As a result of reproducing at the time of the overlapping off-track, the crosstalk quantity of the head (a) decreased by about 8 dB from (b).

[0018]Some ratios of the interval Gse of the magnetic shielding film in a polar-zone position to the interval Gsc of the magnetic shielding film in a magnetic force sensor position and MR heads from which Gse/Gsc differs are produced, and the result of having measured each crosstalk quantity on the above-mentioned conditions is shown in drawing 3. Crosstalk quantity decreased, and when Gse/Gsc was 1-0.6, compared with the head (Gse/Gsc=1.3), crosstalk quantity decreased by 6.5-8 dB conventionally, so that Gse/Gsc was small. At this example, it is the limit of thin-film-izing of an insulator layer to Gse/Gsc 0.6 It was difficult to carry out the following.

[0019]In the head of this example, it has checked conventionally that the output operated stably from the head, without a reproducing output declining, even after the magnetic field from a recording head was impressed to the MR head.

[0020](Example 2) The sectional view of the magnetic head applied to the giant magneto-resistance type head is shown in drawing 4 as another example by this invention. In production of this head, the lower part shield film (NiFe film) 10 and the insulator layer 20 for magnetic gap formation (AlO film) were formed like Example 1 on the substrate 5, and what laminated NiFe/Co, Cu, CoFe, and FeMn one by one was used as the giant magneto-resistance film 100. Next, after laminating an organic resist film, it patterns after desired shape, and it is a permanent magnet film further. (CoCrPt film) After laminating 60 and processing desired shape, Nb/Au/ Nb was laminated and processed and it was considered as the electrode 70. The insulator layer 80 for magnetic gap formation (AlO film) was formed so that the same level difference as Example 1 might stick. Furthermore, the 2-micrometer-thick upper shielding film (NiFe film) 90 was laminated on it, desired shape was processed, and it was considered as the magnetic head.

[0021]Also in the GMR head in this example, the interval Gse of the magnetic shielding film in a polar-zone position is narrower than the interval Gsc of the magnetic shielding film in a magnetic force sensor position, and Gse/Gsc is 0.6.

[0022]The GMR head by this invention had few skirt spread [in / compared with the

conventional GMR head of 1.3 / in Gse/Gsc / the sensitivity distribution of a track width direction], and the crosstalk quantity by the measurement shown in Example 1 decreased by about 10 dB.

[0023]It has checked conventionally that the output operated stably from the head, without a reproducing output declining, even after the magnetic field from a recording head was impressed to the MR head at the GMR head of this invention.

[0024](Example 3) The magneto resistance effect element of this invention was used for the head for reproduction, and the record reproduction discrete type magnetic head using a publicly known induction type thin film head as a head for record was produced conventionally. The perspective view which cut a part of record reproduction discrete type head by this example is shown in drawing 5. The sintered compact which uses AlO-TiC as the main ingredients was used as the substrate 5 for sliders. The lower part shield film 10 which provided the level difference by the method shown in said Example 1, and the insulator layer for magnetic gap formation (AlO film) were produced. After laminating the soft magnetism film (NiFeNb film) 30, the nonmagnetic conducting film (Ta film) 40, the magneto resistance effect film (NiFe film) 50, and an organic resist film moreover, it patterned after desired shape. After laminating the permanent magnet film (CoCrPt film) and processing desired shape, Nb/Au/Nb70 was laminated and processed and it was considered as the electrode. The magnetic gap formation film (AlO film) and the magnetic shielding film (NiFe film) 90 which furthermore provided the same level difference as said Example 1 on it were formed. The above portion works as a playback head.

[0025]Next, after forming the insulator layer which consists of 3-micrometer-thick AlO as a head for magnetic recording, the induction type thin film head which consists of the lower magnetic pole 110, the upper magnetic pole 120, and the coil 130 was formed. 3.0 micrometers of thickness formed in the lower magnetic pole 110 and the upper magnetic pole 120 by sputtering process The nickel-20at% Fe alloy was used. AlO of 0.2 micrometer of thickness formed by sputtering process was used for the gap between the lower magnetic pole 110 and the upper magnetic pole 120. Cu of 3.0 micrometers of thickness was used for the coil 130. It joined together magnetically, and the lower magnetic pole 110 and the upper magnetic pole 120 constituted the magnetic circuit, and have interlinked the coil 130 to the magnetic circuit.

[0026]The record reproduction discrete type magnetic head by this invention also had few skirt spread in the sensitivity distribution of a track width direction compared with the conventional head, and the crosstalk quantity by the measurement shown in Example 1 decreased by about 8 dB.

[0027](Example 4) The magnetic disk drive was produced using the magnetic head by this invention described in said Example 3. The outline of the structure of a magnetic disk drive is

shown in drawing 6.

[0028]The material which consists of a Co-nickel-Pt-Ta system alloy of the residual magnetic flux density 0.75T was used for the magnetic recording medium 140. The magnetic recording medium 140 is rotated by the actuator 150. As for the width of recording track of the recording head of the magnetic head 160, the width of recording track of 2 micrometers and a playback head is 1.5 micrometers. It carried out. The magnetic head 160 is rotated by the actuator 170, and can choose the track on the magnetic recording medium 140. The record reproduction signal by the magnetic head 160 is processed by the record reproduction signal-processing system 180.

[0029]Since the magnetoresistance head used for the magnetic head 160 has a small cross talk from an adjacent track and its output is also more stable than the magnetoresistance head of the conventional structure, it can also produce a magnetic disk drive with the still narrower width of recording track and high storage density.

[0030]

[Effect of the Invention]Since the magnetic field impressed to the width-of-recording-track both ends of the magnetic force sensor in a magneto resistance effect type reproduction head decreases according to this invention, a blot of the reproduction sensitivity of a track width direction can be reduced, and the cross talk from an adjacent track can be reduced. The magneto resistance effect type reproduction head which has a stable reproducing output can be obtained.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The sectional view of the magneto resistance effect type head by this invention.
[Drawing 2]The figure showing the sensitivity distribution of the track width direction in a head the head by this invention, and conventionally.
[Drawing 3]the ratio of the shielding space Gse in a polar-zone position to the shielding space Gsc in a magnetic force sensor position -- the figure showing the relation of a crossed rack amount with Gse/Gsc.
[Drawing 4]The sectional view of the giant magneto-resistance type head by this invention.
[Drawing 5]The perspective view showing the structure of a record reproduction discrete type magnetic head using the magnetic resistance effect type head of this invention.
[Drawing 6]The outline of the recording and reproducing device by this invention.
[Drawing 7]The sectional view of the conventional magneto resistance effect type head.
[Description of Notations]
5 -- A substrate, 10 -- A lower part shield film, 20 -- The insulator layer for lower magnetic gap formation, 30 [-- Permanent magnet film,] -- A soft magnetism film, 40 -- A nonmagnetic conducting film, 50 -- A magneto resistance effect film, 60 70 -- An electrode, 80 -- The insulator layer for top magnetic gap formation, 90 -- Upper shielding film, 100 [-- A coil, 140 / -- A magnetic recording medium, 150 / -- A magnetic-recording-medium actuator, 160 / -- A magnetic head, 170 / -- A magnetic head actuator, 180 / -- Record reproduction signal-processing system.] -- A giant magneto-resistance film, 110 -- The lower magnetic pole for recording heads, 120 -- The upper magnetic pole for recording heads, 130

[Translation done.]